NASA Facts

National Aeronautics and
Space Administration

Lyndon B. Johnson Space Center
Houston, Texas 77058

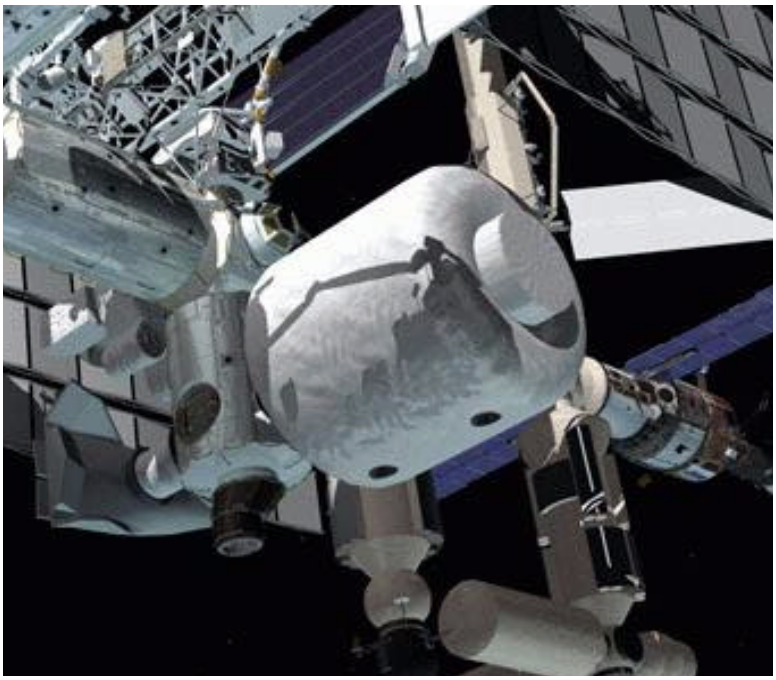
IS-1999-05-ISS027JSC

International Space Station

May 1999

The TransHab Module: *An Inflatable Home in Space*

When the Montgolfier brothers became the first human beings to leave the Earth's surface aboard a hot-air balloon in the 18th Century, they may have dreamed of flying to space, and now the first inflatable spacecraft has arrived, a proposed crew quarters for the International Space Station that may take flight in the 21st Century.



Artist's concept showing the TransHab living quarters attached to the completed International Space Station.

But with walls over a foot thick – providing better protection than metal against space debris -- this inflatable spacecraft, called TransHab, is far from a balloon. The inflatable module would be a home for up to six astronauts aboard the station, complete with bedrooms, a kitchen, a dining table that seats 12, two windows, a gym and a pantry. As the first inflatable spacecraft, TransHab also could be a stepping stone to future space exploration. Inflatable spacecraft may have a great potential for use aboard a Mars-bound spaceship and as inflatable shelters on the Moon or Mars.

TransHab By the Numbers	
Weight at launch	29,000 pounds
Length at launch	36 feet
Diameter at launch	14 feet
Diameter after inflation	27 feet
Inflated volume	12,000 cubic feet
(Volume comparable to a 1,500 square foot home)	

Because it is inflatable, TransHab would provide more room and weigh much less per cubic foot than conventional metal station modules. Although smaller when folded for launch aboard the Space Shuttle, once on the station and inflated it

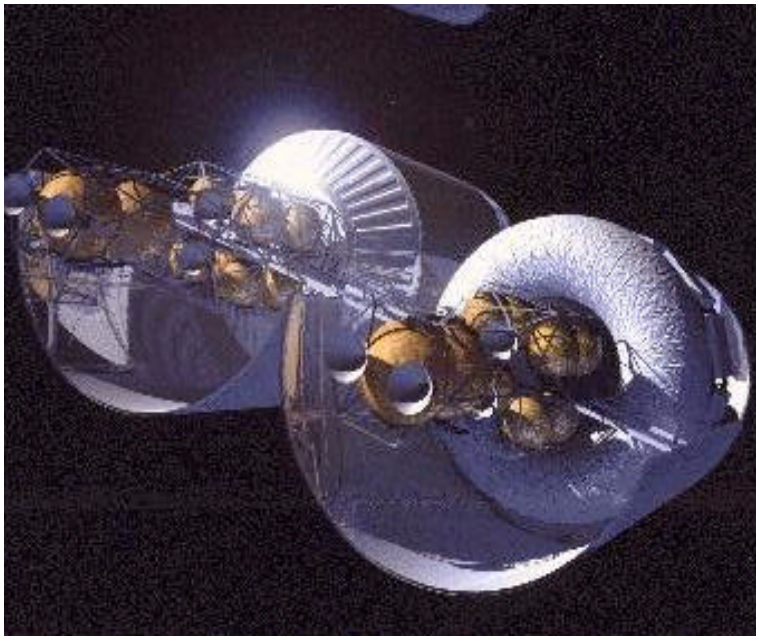
would be almost three times as big as other modules. Its size would double the storage space available on the station. Composed of almost two dozen layers of materials, testing has shown that the shell of TransHab can provide protection from space debris that may be traveling more than 15,500 miles per hour. Thanks to an innovative design that hastens the break up of particles, a projectile as large as two-thirds of an inch will not even penetrate deep enough into the shell to reach protective layers of super-strong Kevlar fabric, the same fabric used to make bullet-proof vests on Earth.

The concept for the TransHab inflatable module originated at NASA's Lyndon B. Johnson Space Center, Houston, in 1997 as a possible design for a living quarters on future Mars-bound spacecraft. Potential benefits of the concept for use as an International Space Station module quickly became apparent, and further development and testing of a proposed station module followed. In September 1998, a 23-foot diameter TransHab test unit was lowered into the giant 6.2 million gallon water tank at JSC's Neutral Buoyancy Laboratory.

The unit was successfully tested to hold air pressure four times as great as Earth's atmosphere at sea level, proving the strength of TransHab's shell. In November 1998, a full-scale test unit was installed in JSC's giant, seven-story vacuum chamber, one of the largest in the world, to imitate the airless environment of space. TransHab was put through the paces in the large vacuum chamber, taken from the deflated and folded stage it would be in for launch through fully inflated as it would be after it is attached to the station.

A final decision on whether or not TransHab will officially become a part of the station is expected this year. It would be scheduled for launch aboard the Space Shuttle in 2004 as the last component in the station's orbital assembly sequence.

Benefits Beyond Today – *The technology of inflatable structures may find uses in future space exploration beyond Earth orbit, for interplanetary spacecraft or as the ultimate "mobile home" on the Moon or Mars. In addition to benefits for the space station, a concept like TransHab may provide a valuable test of technologies that pave the way to the future in space.*

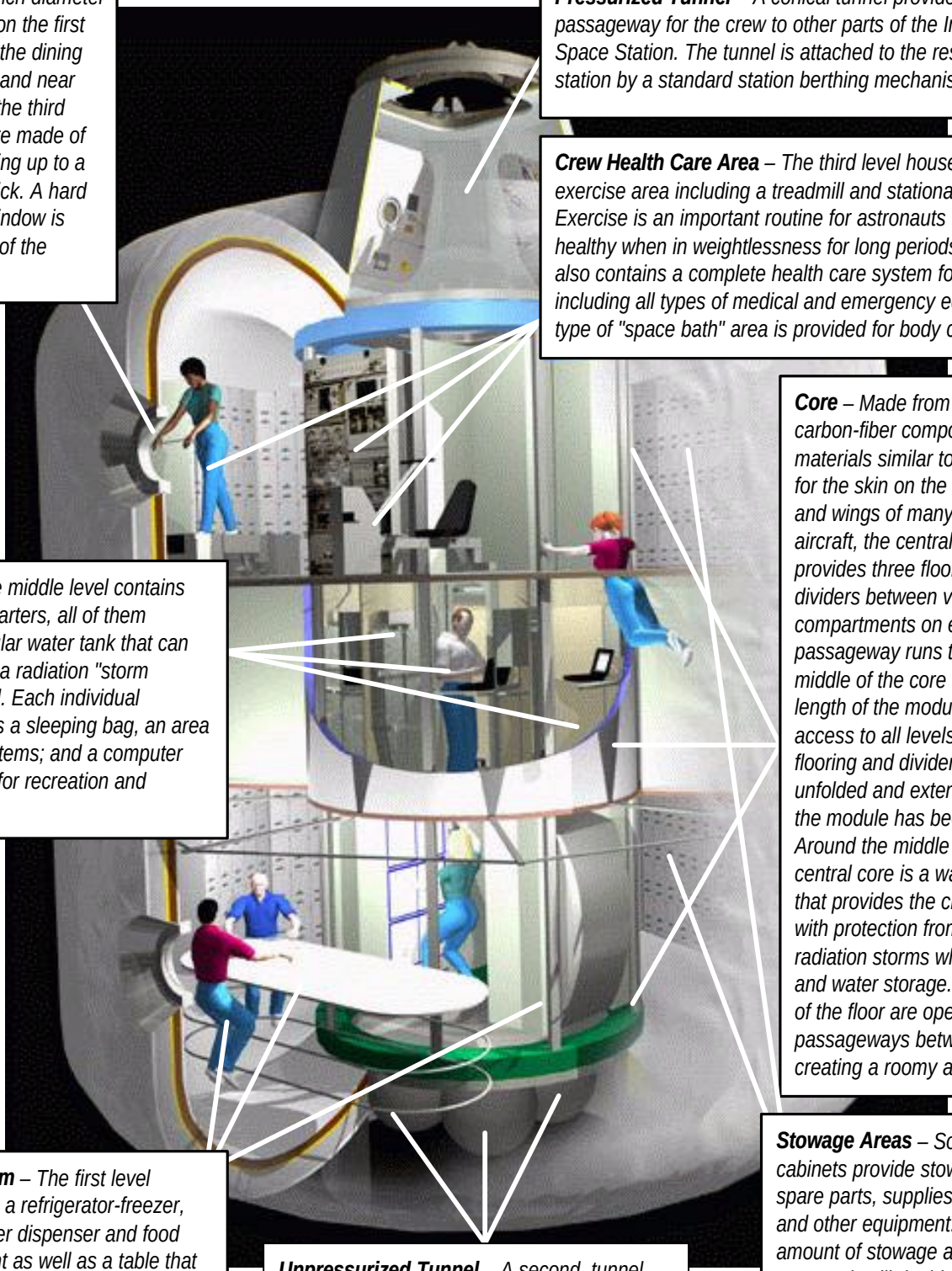


Onboard TransHab: *A Home Away From Home*

Windows *– Two 20-inch diameter windows are located on the first and third levels, near the dining area on the first level and near the exercise area on the third level. The windows are made of four panes each, adding up to a total of four inches thick. A hard frame around each window is attached to all layers of the TransHab shell.*

Pressurized Tunnel *– A conical tunnel provides a passageway for the crew to other parts of the International Space Station. The tunnel is attached to the rest of the station by a standard station berthing mechanism.*

Crew Health Care Area *– The third level houses a crew exercise area including a treadmill and stationary bicycle. Exercise is an important routine for astronauts to stay healthy when in weightlessness for long periods. The area also contains a complete health care system for the station, including all types of medical and emergency equipment. A type of "space bath" area is provided for body cleansing.*



Core *– Made from lightweight carbon-fiber composite materials similar to those used for the skin on the fuselage and wings of many modern aircraft, the central core provides three floors and dividers between various compartments on each floor. A passageway runs through the middle of the core for the length of the module, providing access to all levels. The flooring and dividers are unfolded and extended after the module has been inflated. Around the middle level of the central core is a water tank that provides the crew quarters with protection from solar radiation storms when needed and water storage. Some areas of the floor are open as passageways between levels, creating a roomy atrium effect.*

Crew Quarters *– The middle level contains six individual crew quarters, all of them surrounded by a circular water tank that can provide protection as a radiation "storm shelter" when needed. Each individual compartment contains a sleeping bag, an area for stowing personal items; and a computer entertainment center for recreation and personal work.*

Galley and Wardroom *– The first level houses a kitchen with a refrigerator-freezer, microwave oven, water dispenser and food preparation equipment as well as a table that is capable of seating 12, enough to allow an entire station resident crew and replacement crew to sit together for meetings or meals.*

Unpressurized Tunnel *– A second tunnel houses the compressed air tanks used for the initial inflation of TransHab as well as other exterior equipment. This tunnel does not contain air and is not a part of the living area.*

Stowage Areas *– Soft-sided cabinets provide stowage for spare parts, supplies, clothing and other equipment. The amount of stowage available in TransHab will double the stowage room available on the International Space Station.*

TransHab's Inflatable Shell: *Stronger Than Metal*

With almost two dozen layers, TransHab's foot-thick inflatable shell is a marvel of innovative design. The layers are fashioned to break up particles of space debris and tiny meteorites that may hit the shell with a speed seven times as fast as a bullet. The outer layers protect multiple inner bladders, made of a rubber-like material that holds in the module's air. The shell also provides insulation from temperatures in space that can range from plus 250 degrees Fahrenheit in the Sun to minus 200 degrees in the shade.

The keys to the debris protection are successive layers of Nextel, a material commonly used as insulation under the hoods of many cars, spaced between several-inches-thick layers of open cell foam, similar to foam used for chair cushions on Earth. The Nextel and foam layers cause a particle to shatter as it hits, losing more and more of its energy as it penetrates deeper.

Many layers into the shell is a layer of superstrong woven Kevlar that holds the module's shape. The air is held inside by three bladders of Combitherm, a material commonly used in the food-packing industry. The innermost layer, forming the inside wall of the module, is fireproof nomex cloth, a felt-like material that protects from scuffs and scratches.